FEMORAL NECK COMPRESSION SCREW SYSTEM WITH ORTHO-BIOLOGIC MATERIAL DELIVERY CAPABILITY

RELATED APPLICATIONS

This application claims the benefit of the filing date of U. S. Provisional Application No. 60/444,735 filed Feb. 3, 2003 under 35 U.S.C. 119(e).

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of orthopedic surgery and, in particular, the treatment of fractures by implantation of bone screws for compression and medication.

2. Description of the prior art

The use of bone screws for stabilization and fixation of fractures is conventional. The use of lag screws for compression of fractures is also conventional, as shown by McCarthy, U. S. Patent No. 5,514,138.

Lag screws and anchors with additional holding devices are taught by Bramlet, U. S. Patent No. 5,849,004 and U. S. Patent No. 6,443,954. These devices have curved talons which deploy from the interior of a cannulated body to increase the holding power.

Bone pins or screws have been used to access the interior of bones for application of diagnostic and structural components. For example, Kyle, U. S. Patent

No. 4,760,844, teaches the use of a cannulated screw for applying X-ray opaque dye and U. S. Patent No. 4,653,489 teaches the use of a cannulated lag screw to apply polymethylmethacrylate (PMMA) or bone cement to the interior of a broken bone. In both these devices, the exuded material exits near the distal end of the screw which places the material in the immediate area of the screw threads.

What is lacking in the prior art is a lag screw with devices to increase the holding power of the screw and medicate the afflicted area while maintaining the ability to remove the devices and the screw.

SUMMARY OF THE PRESENT INVENTION

A device for the treatment of a femoral neck trauma which includes basilar, mid-cervical and sub-cap fractures. The device is a compression screw assembly having a side plate, a compression screw and a cortical screw, which are implantable. A syringe adaptor instrument delivers ortho-biologic material to the fracture site through the lag screw. The lag screw assembly utilizes a cannulated screw with external threads and deployable tangs to anchor into the femoral head and is implanted in such a manner as to have the lag screw threads and tangs located on the opposite side of the fracture from the side plate. The distal shaft of the lag screw interfaces with the side plate in a manner which allows axial translation only. To deliver ortho-biologic material to the fracture site, the syringe adaptor instrument is inserted into the cannulated lag screw prior to the installation of the compression screw and the material is forced through it and out exit holes located circumferentially

around the lag screw between the fracture site and the deployable tangs.

Thus, an objective of this invention is to repair fractures with a compression screw assembly exerting compression across of the fragments of the bone.

Another objective is to inject a biological material through the compression screw assembly into the area of the fracture to aid in recovery.

A further objective of this invention is to provide the lag screw assembly with a separation between the screw threads and the injection ports.

Yet another objective of this invention is to provide the injection assembly with a seal between the injection ports and the screw threads.

Other objectives and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this invention. The drawings constitute a part of this specification and include exemplary embodiments of the present invention and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective of the compression screw assembly;

Fig. 2 is a perspective of the compression screw assembly and the biological material syringe;

Fig. 3 is a perspective of the compression screw assembly and syringe in situ in a hip joint;

Fig. 4 is a side view of the lag screw showing extended tang legs;

Fig. 5 is a composite a side view of the lag screw including an end view of the leading end and the trailing end of the lag screw;

Fig. 6 is a side view, partially in section, of the lag screw;

Fig. 7 is a composite of the side plate showing a side view a front view and a bore view;

Fig. 8 is a side view of the syringe and adapter;

Fig. 9 is a side view of the adapter showing the exit port;

Fig. 10 is a longitudinal cross section of the compression screw assembly with the syringe and syringe adapter in place; and

Fig. 11 is a longitudinal cross section of the lag screw and adapter showing the deployment of the tangs and location of the material discharge hole with the exit port.

DETAILED DESCRIPTION OF THE INVENTION

The implantable components 1, constructed of stainless steel or titanium alloy, or other medically acceptable materials shown in Fig. 1 include the lag screw assembly 2, side plate 3, compression screw 4 and cortical screw 5. Fig. 2 illustrates the implantable assembly 1, less compression screw 4, with syringe adaptor 6 and syringe 7 assembled to deliver ortho-biologic material to the fracture site 8, shown in Fig. 3 through the lag screw assembly 2. Fig. 3 also illustrates proper placement of the implant assembly with tang legs 9 and screw thread 11 located on the proximal side of fracture 8 and side plate 3 on the distal side of fracture 8 and ortho-biologic material discharge holes 12 in close proximity of the fracture 8.

The lag screw assembly 2, as shown in Figs. 5 and 6, contains two concentric bores, the tang clearance bore 28 and compression screw bore 16 which is threaded for engagement with compression screw 4. An end cap 13 is utilized to capture the tang body 14 within the clearance bore 18. The end cap 13 has a clearance bore through it to allow passage of a guide wire (not shown) during the installation of the lag screw assembly 2. Ortho-biologic material discharge holes 12 extend through the lag screw assembly 2 wall into the tang clearance bore 18. The tang body 14, shown in the deployed position, consists of a body with four integral tang legs 9 and a threaded bore 15. In its non-deployed position, the entire tang is contained within lag screw assembly tang bore 18. Deployment of tang 14 occurs when the tang 14 is translated toward the end cap 13 at which time tang legs 9 are forced out of tang exit holes 29. Tang threaded bore 15 provides clearance for a guide wire during lag

screw assembly 2 installation and instrument interface for tang 14 retraction. The non-threaded portion 10 of lag screw body 19, in its preferred embodiment, has an octagonal cross section.

The side plate 3, in Fig. 7, consists of a body 21 and barrel 20. The body 21 contains a through hole 22 for cortical screw 5 clearance. The barrel 20 contains octagonal bore 23 which is sized to allow insertion of the compression screw octagonal body portion 10 and a sliding fit thereby allowing only translation without rotation. The compression screw 4 inserts through side plate barrel 20 and threads into lag screw threaded bore 16 when the lag screw assembly octagonal body 10 is inserted into lag screw barrel octagonal barrel bore 23. As the compression screw 4 is advanced, the head of compression screw 4 contacts and reacts with side plate 3 and forces lag screw assembly 2 to translate distally. Since lag screw threads 11 and tang legs 9 are engaged into bone on the proximal side of the fracture 8 and the side plate 3 is located on the distal side of fracture 8, fracture 8 is reduced or compressed. Cortical screw 5 is threaded into bone through clearance hole 22 preventing translation or rotation of side plate 3 and since relative rotation is prevented as previously described between lag screw 2 and side plate 3 and the tang legs 9 are engaged in the bone of the femoral head, rotation of the femoral head and fracture is prevented.

The syringe adaptor 6, in Fig. 8, has a standard Leuer interface 31 at one end for connection to any standard syringe 7. At the opposite end of the syringe adaptor 6 is an external thread 26 a exit port 25 and a shoulder 24. An internal bore 27, shown

in Fig. 11, runs the entire length of syringe adaptor 6 to the exit port 25 and intersects the exit port 25 but does not continue into the external thread 26. After implanting the implant assembly 1 less the compression screw 4 the syringe adaptor 6 is inserted through side plate barrel bore 23, through lag screw assembly compression screw bore 16, through lag screw assembly tang clearance bore 18. The external thread 26 of syringe adaptor 6 is then engaged into threaded bore 15 of tang body 14 and advanced until shoulder 24 of syringe adaptor 6 makes contact with lag screw assembly shoulder 17. At this point syringe 7 is attached to syringe adaptor 6 by means of the Leuer interface 31 of Fig. 10 or any other connector.

To introduce the ortho-biologic material, plunger 30 of syringe 7 is depressed forcing the material through the internal bore 27 of syringe adaptor 6 and out the syringe adaptor fluid exit port 25 into the lag screw assembly tang clearance bore 18. For example, the ortho-biological material may be selected from such groups of substances as bone cements, such as PMMA and other adhesives, BMP, bone morphogenic proteins, DBM, demineralized bone matrix, BOTOX and other viral vectors, any bone marrow aspirate, platelet rich plasma, composite ceramic hydroxyapatite, tricalcium phosphate, glass resin mixtures, resorbable highly purified polylacttides/polylactides-co-glycolides and others. The treating agent may include hormonal, antibiotic, anti-cancer, or growth factor substances, among others.

With tang body 14 having a close fit in lag screw assembly tang clearance bore 18 and syringe adaptor external thread 26 engaged in tang body internal thread 15 and syringe adaptor shoulder 24 in contact with lag screw assembly shoulder 17, the

fluid is forced to exit through lag screw assembly ortho-biologic material exit holes 12 and into the proximity of the fracture 8. After, the material is delivered, the syringe adaptor 6 is removed and compression screw 4 is engaged and the fracture 8 is compressed/reduced as previously described.

It will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the invention is not to be limited by the specific illustrated embodiment but only by the scope of the appended claims.